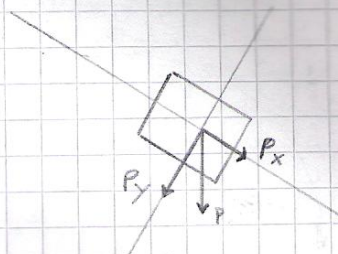
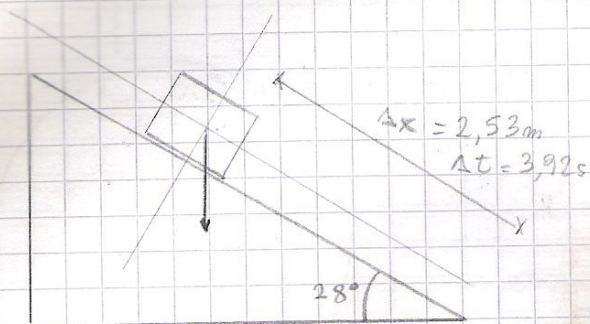


# ROZAMIENTO

5



$$\begin{aligned} \text{b) } \Sigma F_x &= m \cdot a \\ P_x - F_{Rg} &= m \cdot a \end{aligned} \quad \left\{ \begin{aligned} y &= y_0 + v_{y0} t + \frac{1}{2} a t^2 \\ y &= \frac{1}{2} a t^2 \Rightarrow \frac{2y}{t^2} = a \end{aligned} \right.$$

$$m \cdot g \cdot \text{Sen} \alpha - m \cdot g \cdot \cos \alpha \cdot \mu_d = m \cdot \frac{2y}{t^2}$$

$$-g \cos \alpha \mu_d = \frac{2y}{t^2} - g \text{Sen} \alpha$$

$$\mu_d = \frac{\frac{2y}{t^2} - g \cdot \text{Sen} \alpha}{-g \cdot \cos \alpha}$$

$$\mu_d = \frac{0,32 - 4,60}{8,65} = 0,49$$

$$\boxed{\mu_d = 0,49} \quad \checkmark$$

$$P_y = P \cdot \cos \alpha \Rightarrow P_y =$$

$$P_x = P \cdot \text{Sen} \alpha \Rightarrow P_x =$$

$$\Sigma F_x = m \cdot a$$

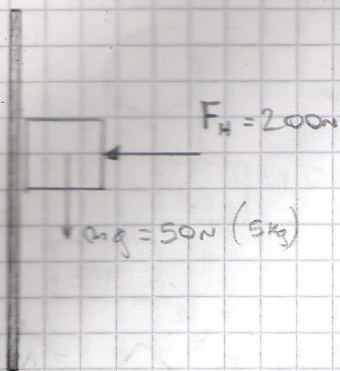
$$P_x - F_R = m \cdot a$$

$$m \cdot g \cdot \text{Sen} \alpha - m \cdot g \cdot \cos \alpha \cdot \mu_e = m \cdot a$$

$$\mu_e = \frac{-m \cdot g \cdot \text{Sen} \alpha}{m \cdot g \cdot \cos \alpha} \Rightarrow \mu_e = \text{tg} \alpha$$

$$\text{a) } \boxed{\mu_e = 0,53} \quad \checkmark$$

⑥



a)  $\Sigma F_x = m \cdot a$   
 $N - F_H = 0$   
 $N = F_H$

$\Sigma F_y = m \cdot a$

$P - F_{re} = 0$

$mg - F_H \cdot \mu = 0$

$\mu = \frac{-mg}{-F_H}$

$\mu = 0,25$

$F_{re} = \mu \cdot F_H \Rightarrow F_{re} = 50 \text{ N}$

b)  $\mu_e = 0,4$

$\Sigma F_y = m \cdot a$

$P - F_{re} = m \cdot a$

$-F_{re} = -P$

$-N = \frac{-P}{\mu} \Rightarrow N = +125$

$\Sigma F_x = m \cdot a$

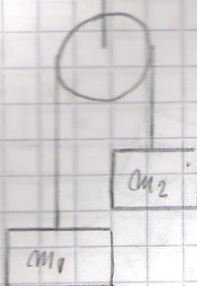
$N - F_{min} = m \cdot a$

$125 \text{ N} - F_{min} = 0$

$F_{min} = 125 \text{ N}$

7

Masses



$$m_1 + m_2 = 10 \text{ kg}$$

$$a = 2 \text{ m/s}^2$$

$$g = 10 \text{ m/s}^2$$

$$T_1 = T_2$$

$$(10 - m_2)(g + a) = m_2(g - a)$$

$$(10 - m_2)g + (10 - m_2)a = m_2g - m_2a$$

$$10g - m_2g + 10a - m_2a = m_2g - m_2a$$

$$10g + 10a - m_2a + m_2a = m_2g + m_2g$$

$$\frac{10g + 10a}{2g} = m_2$$

$$m_2 = \frac{100 + 20}{20} \Rightarrow m_2 = 60 \text{ N}$$

$$m_2 = 6 \text{ kg}$$

$$\sum F_y = m \cdot a$$

$$T_1 - (10 - m_2) \cdot g = (10 - m_2) \cdot a$$

$$T_1 = (10 - m_2)g + (10 - m_2)a$$

$$T_1 = (10 - m_2) \cdot (g + a)$$



$$m_2$$

$$-T_2 + m_2 \cdot g = m_2 \cdot a$$

$$-T_2 = m_2 \cdot a - m_2 \cdot g$$

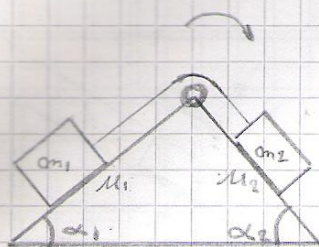
$$T_2 = m_2 \cdot g - m_2 \cdot a$$

$$T_2 = m_2 \cdot (g - a)$$



$$\frac{10 \text{ kg} \cdot \text{m/s}^2 + 10 \text{ kg} \cdot \text{m/s}^2}{\text{m/s}^2} \Rightarrow \frac{20 \text{ kg} \cdot \text{m/s}^2}{\text{m/s}^2}$$

8



$$m_1 = 1000 \text{ N (100 kg)}$$

$$a = ?$$

$$m_2 = 800 \text{ N (80 kg)}$$

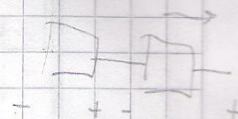
$$T_1 = ?$$

$$\alpha_1 = 30^\circ$$

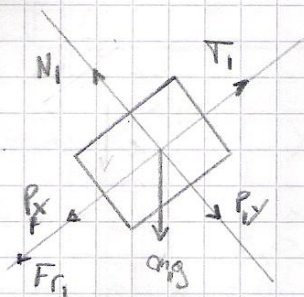
$$T_2 = ?$$

$$\alpha_2 = 60^\circ$$

$$\mu_1 = \mu_2 = 0,1$$



[m1]



$$P_{1x} = P_1 \cdot \sin \alpha_1 \Rightarrow P_{1x} = 500 \text{ N}$$

$$P_{1y} = P_1 \cdot \cos \alpha_1 \Rightarrow P_{1y} = 860 \text{ N}$$

$$\sum F_{x1} = m_1 \cdot a$$

$$T_1 - P_{1x} - F_{r1} = m_1 \cdot a$$

$$T_1 = m_1 \cdot a + P_{1x} + F_{r1}$$

$$T_1 = T_2$$

$$m_1 \cdot a + P_{1x} + F_{r1} = P_{2x} - F_{r2} - m_2 \cdot a$$

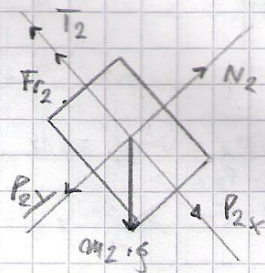
$$a (m_1 + m_2) = P_{2x} - F_{r2} - P_{1x} - F_{r1}$$

$$a = \frac{P_{2x} - F_{r2} - P_{1x} - F_{r1}}{(m_1 + m_2)} \Rightarrow a = \frac{688 \text{ N} - 40 \text{ N} - 500 \text{ N} - 86 \text{ N}}{(100 \text{ kg} + 80 \text{ kg})} \Rightarrow a = 0,34 \text{ m/s}^2$$

$$(100 \text{ kg} + 80 \text{ kg})$$

$$T_1 = m_1 \cdot a + P_{1x} + F_{r1} \Rightarrow T_1 = 100 \text{ kg} \cdot 0,34 \text{ m/s}^2 + 500 \text{ N} + 86 \text{ N} \Rightarrow T_1 = 620 \text{ N}$$

[m2]



$$P_{2x} = P_2 \cdot \sin \alpha_2 \Rightarrow P_{2x} = 688 \text{ N}$$

$$P_{2y} = P_2 \cdot \cos \alpha_2 \Rightarrow P_{2y} = 400 \text{ N}$$

$$\sum F_{x2} = m_2 \cdot a$$

$$P_{2x} - T_2 - F_{r2} = m_2 \cdot a$$

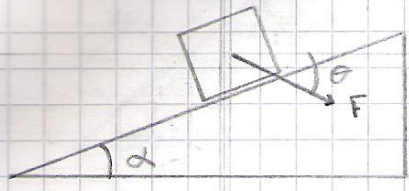
$$-T_2 = m_2 \cdot a - P_{2x} + F_{r2}$$

$$T_2 = P_{2x} - F_{r2} - m_2 \cdot a$$

$$F_{r1} = \mu \cdot P_{1y} \Rightarrow F_{r1} = 86 \text{ N}$$

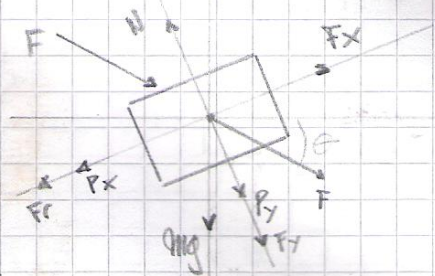
$$F_{r2} = \mu \cdot P_{2y} \Rightarrow F_{r2} = 40 \text{ N}$$

10



$m = 100 \text{ kg}$   
 $\mu = 0,25$   
 $\alpha = 30^\circ$   
 $\theta = 7^\circ$

$F_{\min} = ?$



$$\sum F_x = m \cdot a$$

$$F_x - F_r - P_x = m \cdot a$$

$$(\cos \alpha + \theta) \cdot F_{\min} - \mu \cdot N - \sin \alpha \cdot mg = m \cdot a$$

$$F_x = \cos \alpha + \theta \cdot F_{\min}$$

$$F_y = \sin \alpha + \theta \cdot F_{\min}$$

$$P_y = \cos \alpha \cdot mg$$

$$\sum F_y = m \cdot a$$

$$N - P_y - F_y = m \cdot a$$

$$N = P_y + F_y$$

$$(\cos \alpha + \theta) \cdot F_{\min} - \mu \cdot (\cos \alpha \cdot mg + \sin \alpha + \theta \cdot F_{\min}) - \sin \alpha \cdot mg = m \cdot a$$

$$(\cos \alpha + \theta) \cdot F_{\min} = \mu (\cos \alpha \cdot mg + (\sin \alpha + \theta) \cdot F_{\min}) + \sin \alpha \cdot mg$$

$$\mu \cos \alpha \cdot mg + \mu (\sin \alpha + \theta \cdot F_{\min}) + \sin \alpha \cdot mg$$

$$(\cos \alpha + \theta) \cdot F_{\min} - \mu (\sin \alpha + \theta) \cdot F_{\min} = \mu \cos \alpha \cdot mg + \sin \alpha \cdot mg$$

$$F_{\min} = \frac{\mu \cos \alpha \cdot mg + \sin \alpha \cdot mg}{\cos \alpha + \theta - \mu \cdot \sin \alpha + \theta}$$

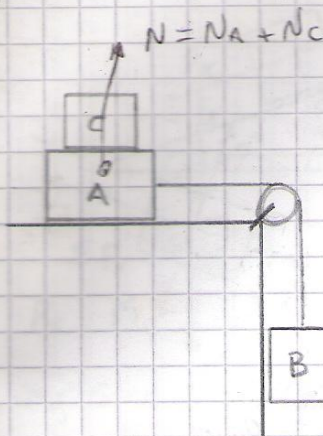
$$F_{\min} = \frac{216,5 + 500}{0,79 - 0,15} \Rightarrow F_{\min} = \frac{716,5}{0,64}$$

$$F_{\min} = 1119 \text{ N}$$

$$248,13 + 121,8$$

LA NO... EN (M...), ES NC+NA?  
 O ES SOLO  $m_c \cdot g = N_c$ ?  $N_{TA} =$

(11)

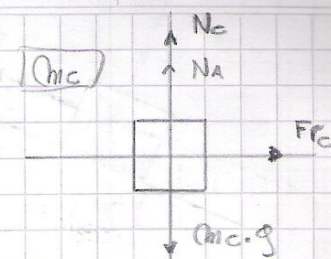


$$m_A = 20 \text{ kg}$$

$$m_c = 10 \text{ kg}$$

$$\mu_e = 0,2$$

$$\mu_c = 0,1$$



$$\sum F_{xc} = m_c \cdot a$$

$$F_{rc} = m_c \cdot a$$

$$\sum F_{yc} = m_c \cdot a$$

a

$$③ T_1 - F_{rA} = m_A \cdot a \quad ; \quad ② m_B \cdot g - T_2 = m_B \cdot a$$

$$T_1 = T_2$$

$$F_{rA} = m_B \cdot g$$

$$\mu_e \cdot N_A = m_B \cdot g$$

$$N_A = \frac{m_B \cdot g}{\mu_e} \Rightarrow N_A = 500 \text{ N}$$

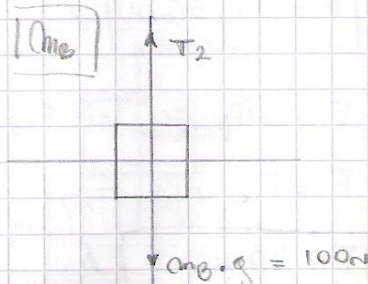
$$Dg \quad ④ m_A \cdot g + F_{rc} - N_A = m_A \cdot a$$

$$m_A \cdot g + m_c \cdot g = N_A$$

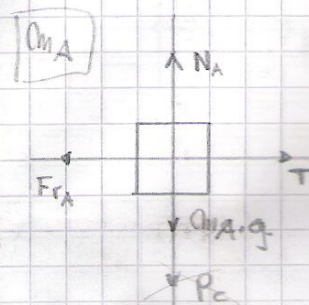
$$m_A \cdot g - N_A = -m_c \cdot g$$

$$-\left( \frac{m_A \cdot g - N_A}{g} \right) = m_c$$

$$m_c = 30 \text{ kg}$$



$$② \sum F_{yb} = m_B \cdot g - T_2 = m_B \cdot a$$



$$\sum F_{xA} = m_A \cdot a$$

$$③ T - F_{rA} = m_A \cdot a$$

$$\sum F_{yA} = m_A \cdot a$$

$$④ m_A \cdot g + F_{rc} - N_A = m_A \cdot a$$

49-93

b

$$Dg \quad ③ T - F_{rA} = m_A \cdot a \Rightarrow T_1 = m_A \cdot a + F_{rA}$$

$$Dg \quad ② m_B \cdot g - T_2 = m_B \cdot a \Rightarrow T_2 = -(m_B \cdot a) + m_B \cdot g$$

$$m_A \cdot a + F_{rA} = -(m_B \cdot a) + m_B \cdot g$$

$$a(m_A + m_B) = m_B \cdot g - \mu_e \cdot N_A$$

$$a = \frac{m_B \cdot g - \mu_e \cdot m_A \cdot g}{m_A + m_B} \Rightarrow a = \frac{100 \text{ N} - 20 \text{ N}}{30 \text{ kg}}$$

$$a = 2,66 \text{ m/s}^2$$

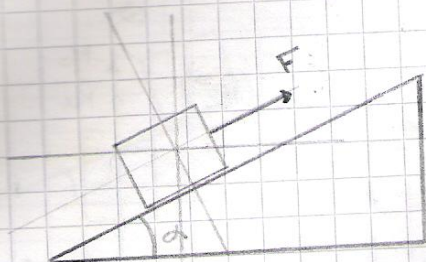
# IDEM EJERCICIO 11.

$$m = 7,96 \text{ kg}$$

$$\alpha = 22^\circ$$

$$\mu_e = 0,25$$

$$\mu_d = 0,15$$



$$P_x = m \cdot g \cdot \sin \alpha \Rightarrow P_x = 29,81 \text{ N}$$

$$P_y = m \cdot g \cdot \cos \alpha \Rightarrow P_y = 73,80 \text{ N}$$

$$F_{re} = N \cdot \mu_e \Rightarrow F_{re} = P_y \cdot \mu_e \Rightarrow 18,45 \text{ N}$$

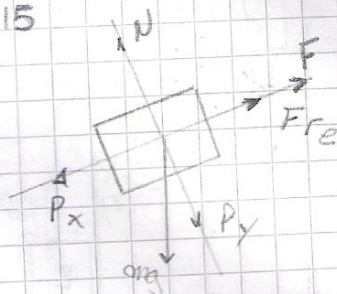
$$F = P_x - F_{re} \Rightarrow F = 29,81 \text{ N} - 18,45 \text{ N}$$

$$\boxed{F = 11,36 \text{ N}} /$$

$$F_{rc} = P_y \cdot \mu_d \Rightarrow F_{rc} = 11,07 \text{ N}$$

$$F = F_{rc} + P_x \Rightarrow F = 11,07 \text{ N} + 29,81 \text{ N}$$

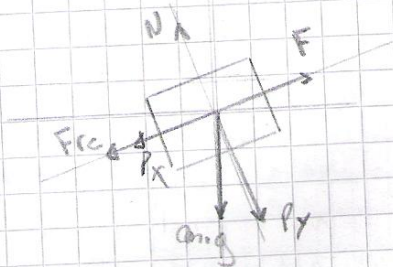
$$\boxed{F = 40,88 \text{ N}} /$$



$$\Sigma F_x = m \cdot a$$

$$P_x - F_{re} - F = m \cdot a$$

$$-F = -P_x + F_{re} \Rightarrow F = P_x - F_{re}$$

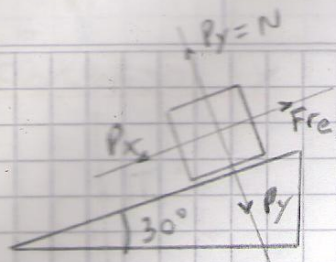


$$\Sigma F_x = m \cdot a$$

$$F - F_{rc} - P_x = m \cdot a$$

$$F = F_{rc} + P_x$$

14



$$P_x = m \cdot g \cdot \sin \alpha$$

$$P_y = m \cdot g \cdot \cos \alpha$$

$$\Sigma F_x = m \cdot a$$

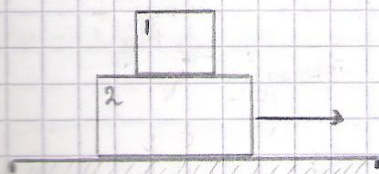
$$P_x - F_{re} = 0$$

$$m \cdot g \cdot \sin \alpha = \mu_e \cdot m \cdot g \cdot \cos \alpha$$

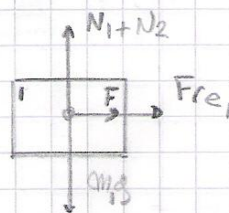
$$\mu_e = \frac{\sin \alpha}{\cos \alpha} \Rightarrow \mu_e = \tan \alpha$$

$$\boxed{\mu_e = 0,57} //$$

15



$$\begin{aligned} m_1 &= 1 \text{ kg} \\ m_2 &= 4 \text{ kg} \\ \mu_e &= 0,3 \end{aligned}$$



$$\Sigma F_x = m \cdot a$$

$$\otimes F + F_{re1} = m \cdot a$$

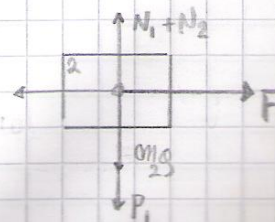
$$F_{re1} = F$$

$$F_{re1} = F_{MAX}$$

$$N_1 + N_2 \cdot \mu_e = F_{MAX}$$

$$49 \cdot 0,3 = F_{MAX}$$

$$\boxed{14,7 \text{ N} = F_{MAX}} //$$



\* PREGUNTAR SI ESTÁ BIEN EL RAZONAMIENTO.

$$\Sigma F_{x2} = m_2 \cdot a_2$$

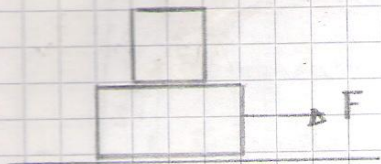
$$F = m_2 \cdot a_2$$

15) PÁG. 7

$$m_1 = 1 \text{ kg}$$

$$m_2 = 4 \text{ kg}$$

$$\mu = 0,3$$

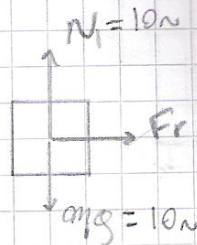


$$\frac{F - F_r}{m_1} = \frac{F - F_r}{m_2}$$

$$\left( \frac{\mu \cdot N}{1} \right) 4 + \mu \cdot N = F$$

$$12 + 3 = 15 \text{ N}$$

$$\boxed{F = 15 \text{ N}} /$$



$$\sum F_x = m a$$

$$\textcircled{1} F_r = m_1 \cdot a$$

$$\mu \cdot N = m_1 \cdot a$$



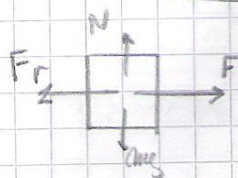
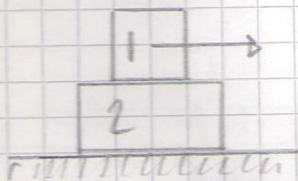
$$\sum F_x = m_2 \cdot a$$

$$F - F_r = m_2 \cdot a$$

$$\textcircled{3} F = (m_2 \cdot a) + F_r$$

$$\textcircled{2} \frac{F - F_r}{m_2} = a$$

16) PÁG. 7



$$F_r = \mu \cdot m_1 g = 3$$

$$\sum F_x = m_1 \cdot a$$

$$F - F_r = m_1 \cdot a$$

$$\frac{F - F_r}{m_1} = a$$



$$\sum F_x = F_r = m_2 \cdot a$$

$$\frac{F_r}{m_2} = a$$

$$\frac{F - F_r}{m_1} = \frac{F_r}{m_2}$$

$$\left( \frac{F_r}{m_2} \right) m_1 + F_r = F$$

$$\boxed{F = 3,75 \text{ N}} /$$